Week Ahead:

M: practice → 2-D elastic/inelastic,
1-D elastic/inelastic

T: practice, lab

W: practice (PSAT for Juniors)

R: Test

F: Exam Review

M: Exam Review

T: Exam

HW Answers:

p. 209: #2 → 1.66 m/s west

#3 → a) 12 m/s

b) 9.6 m/s

p. 214: #1 → 3.8 m/s South

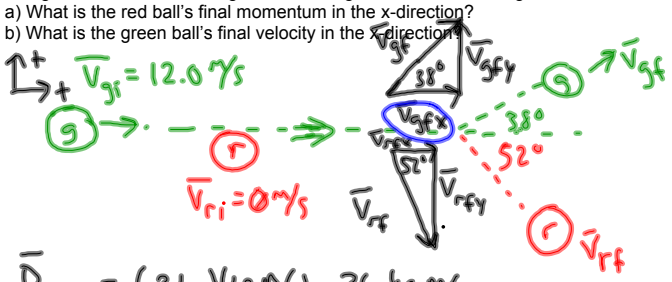
#2 → 1.8 m/s

Collision Practice Problems 1st Block 10.10.11

A green 3.00 kg ball moving 12.0 m/s hits a non-moving red 2.00 kg ball. After they hit, the red ball is moving to the right at a 52.0^0 angle from the green ball's original direction. The green ball is now moving at a 38.0^0 angle to the left of its original direction.

a) What is the red ball's final momentum in the x-direction?

b) What is the green ball's final velocity in the x-direction?



$$\bar{P}_{gix} = (3\,kg)(12\,m/s) = 36\ kg\cdot m/s$$

$$\bar{P}_{giy} = (3\,kg)(0\,m/s) = 0\ kg\cdot m/s$$

$$\bar{P}_{rix} = 0\ kg\cdot m/s$$

$$\bar{P}_{riy} = 0\ kg\cdot m/s$$

$$\bar{P}_{gfx} = m_g v_{gf}\cos(38^0)$$

$$\bar{P}_{gfy} = m_g v_{gf}\sin(38^0)$$

$$\bar{P}_{rfx} = m_r v_{rf}\cos(52^0)$$

$$\bar{P}_{rfy} = -m_r v_{rf}\sin(52^0)$$

$$\bar{P}_{gix} + \cancel{\bar{P}_{rix}^{\,0}} = \bar{P}_{gfx} + \bar{P}_{rfx}$$

$$\cancel{\bar{P}_{giy}^{\,0}} + \cancel{\bar{P}_{riy}^{\,0}} = \bar{P}_{gfy} + \bar{P}_{rfy}$$

$$\bar{P}_{gix} = \bar{P}_{gfx} + \bar{P}_{rfx}$$

$$\bar{P}_{gfy} = -\bar{P}_{rfy}$$

$$\tan(38^0) = \frac{V_{gfy}}{V_{gfx}}$$

$$V_{gfy} = V_{gfx}\tan(38^0) \quad (2)$$

$$V_{rfy} = V_{rfx}\tan(52^0) \quad (3)$$

$$m_g V_{gix} = m_g V_{gfx} + m_r V_{rfx} \quad (1)$$

$$m_g V_{gfy} = -m_r V_{rfy}$$

$$m_g V_{gfx}\tan(38^0) = +m_r(+V_{rfx}\tan(52^0))$$

$$V_{rfx} = V_{gfx}\frac{m_g\tan(38^0)}{m_r\tan(52^0)}$$

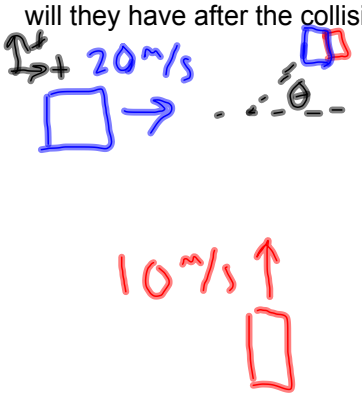
$$m_g V_{gix} = V_{gfx}\left[m_g + \frac{m_g\tan(38^0)}{\tan(52^0)}\right]$$

$$V_{gfx} = \frac{m_g V_{gix}}{m_g + \frac{m_g\tan(38^0)}{\tan(52^0)}}$$

$$= \frac{(3\,kg)(12\,m/s)}{3\,kg + \frac{(3\,kg)\tan(38^0)}{\tan(52^0)}} = 7.45\ m/s$$

Collision Practice Problems 1st Block 10.10.11

A 1000 kg red car travelling north at 10 m/s runs into a 1000 kg blue car traveling east at 20 m/s. If they stick together, what velocity (magnitude, angle, and direction) will they have after the collision?



$$m_b \bar{v}_{bix} + m_r \bar{v}_{rix} = (m_b + m_r)\bar{v}_{fx}$$

$$m_b \bar{v}_{biy} + m_r \bar{v}_{riy} = (m_b + m_r)\bar{v}_{fy}$$

$$m_b \bar{v}_{bix} = (m_b + m_r)\bar{v}_{fx}$$

$$m_r \bar{v}_{riy} = (m_b + m_r)\bar{v}_{fy}$$

$$v_{fx} = \frac{m_b v_{bix}}{m_b + m_r}$$

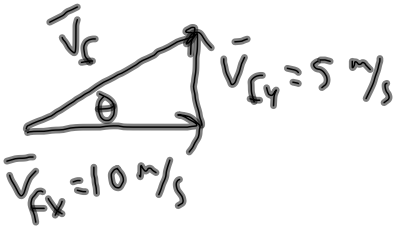
$$= \frac{(1000\ kg)(20\ m/s)}{(1000\ kg + 1000\ kg)}$$

$$= 10\ m/s$$

$$v_{fy} = \frac{m_r v_{riy}}{m_b + m_r}$$

$$= \frac{(1000\ kg)(10\ m/s)}{(1000\ kg + 1000\ kg)}$$

$$= 5\ m/s$$



$$v_f^2 = v_{fx}^2 + v_{fy}^2$$

$$v_f = 11.2\ m/s$$

$$\tan\theta = \frac{v_{fy}}{v_{fx}}$$

$$\theta = 26.6^\circ \quad N\ of\ E$$

$$\bar{v}_f = 11.2\ m/s\ @\ 26.6^\circ\ N\ of\ E$$

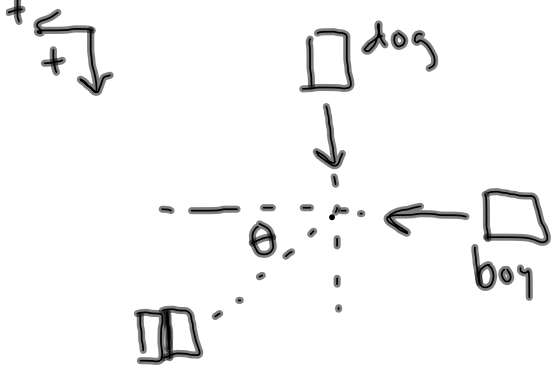
A purple ball traveling east at 8.5 m/s has a mass of 3.0 kg. It hits a non-moving yellow ball with a mass of 5.0 kg. The purple ball ends up moving north of east at an angle of 35.0 degrees and the yellow ball moves south of east at an angle of 55.0 degrees.

a) What is the momentum of the purple ball after impact?

b) What is the velocity of the yellow ball after impact?

Collision Practice Problems 1st Block 10.10.11

A 55.0 kg dog traveling south at 19.5 m/s on her motor scooter collides with a 35.0 kg boy traveling west on his skateboard at 8.62 m/s. Find their velocity (magnitude, angle, and direction) if they stick together after the collision.



$m_d \bar{v}_{dx} + m_b \bar{v}_{bix} = (m_d + m_b)\bar{v}_{fx}$

$m_d \bar{v}_{diy} + m_b \bar{v}_{biy} = (m_d + m_b)\bar{v}_{fy}$

$m_b \bar{v}_{bix} = (m_d + m_b)\bar{v}_{fx}$ $\quad$ $m_d \bar{v}_{diy} = (m_d + m_b)\bar{v}_{fy}$

$$v_{fx} = \frac{m_b v_{bix}}{m_d + m_b}$$

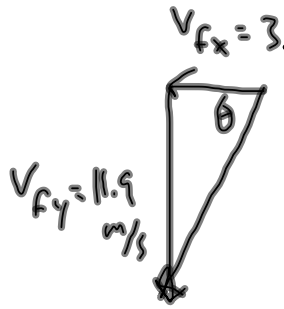
$$= \frac{(35\text{ kg})(8.62\text{ m/s})}{55\text{ kg} + 35\text{ kg}}$$

$$= 3.35\text{ m/s}$$

$$v_{fy} = \frac{m_d v_{diy}}{m_d + m_b}$$

$$= \frac{(55\text{ kg})(19.5\text{ m/s})}{35\text{ kg} + 55\text{ kg}}$$

$$= 11.9\text{ m/s}$$



$$v_f^2 = v_{fx}^2 + v_{fy}^2$$

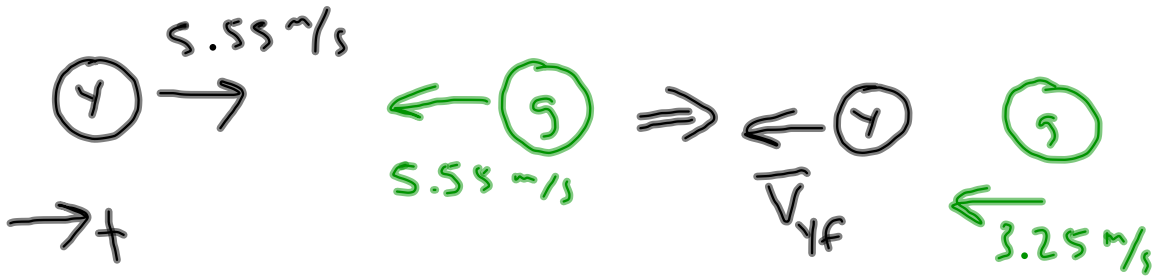
$$v_f = 12.4\text{ m/s}$$

$$\theta = \tan^{-1}\left(\frac{v_{fy}}{v_{fx}}\right)$$

$$= 74.3^\circ \quad \text{S of W}$$

$\bar{v}_f = 12.4$ m/s @ 74.3° S of W

A 1.55 kg yellow sphere moving 5.55 m/s to the right collides head-on with an 8.55 kg green sphere moving 5.55 m/s to the left. After the collision, the green sphere is still moving to the left, but now with a speed of 3.25 m/s. What will the yellow sphere's velocity be afterward?



$$\vec{P}_{yi} + \vec{P}_{gi} = \vec{P}_{yf} + \vec{P}_{gf}$$

$$m_y\vec{V}_{yi} + m_g\vec{V}_{gi} = m_y\vec{V}_{yf} + m_g\vec{V}_{gf}$$

$$V_{yf} = \frac{m_y v_{yi} + m_g v_{gi} - m_g v_{gf}}{m_y}$$

$$= \frac{(1.55\,kg)(5.55\,m/s) + (8.55\,kg)(-5.55\,m/s) - (8.55\,kg)(-3.25\,m/s)}{1.55\,kg}$$

$$= -7.14\,m/s$$